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(74) Agent: **KLEINKE, Bernard, L.**; Foley & Lardner, 23rd
Floor, 402 West Broadway, San Diego, CA 92101-3542
(US).

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(71) Applicant: **SAFETZONE TECHNOLOGIES CORPO-
RATION** [US/US]; 22941 Mill Creek Road, Laguna Hills,
CA 92653 (US).

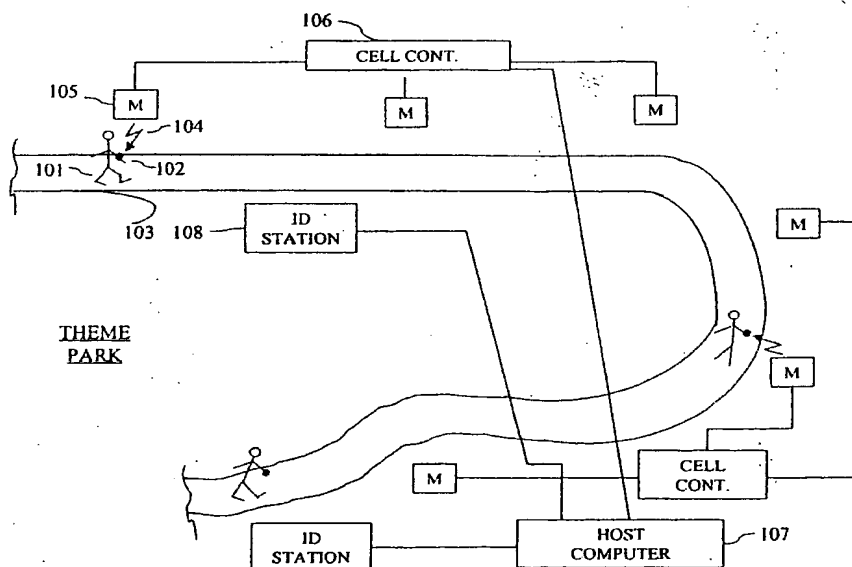
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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM FOR REAL-TIME LOCATION OF PEOPLE IN A FIXED ENVIRONMENT



(57) Abstract: A system is provided for tracking in real-time the location of a group of individuals (101) within a defined environ-
ment, for providing information to an individual user about the location of any other individual of the group and for gaining assistance
to locate and reunite lost individuals. The system uses an identification tag (102) with serial identification tag number worn by each
individual, has means (105) for communicating with each tag as it moves with the individual through the environment and means
(106) for using the communication to determine the position of the tag. The system also uses strategically placed ID stations (108)
distributed within the environment for users to activate a request that the system locate members and for displaying a map indicating
the location.

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8591-206

TITLE OF THE INVENTION

5 **SYSTEM FOR REAL-TIME LOCATION OF PEOPLE IN A FIXED
ENVIRONMENT**

CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable

10 **STATEMENT REGARDING FEDERALLY SPONSORED
RESEARCH OR DEVELOPMENT**

Not applicable

REFERENCE TO A "MICROFICHE APPENDIX"

Not applicable

15 **BACKGROUND OF THE INVENTION**Field of the Invention

20 The present invention relates generally to tracking systems, and more specifically to track in real time the location of individuals of a group within a defined environment such as a theme park or other such fixed activity environment.

Related Art

25 Systems and equipment necessary for tracking a group of individuals in real-time within a defined environment such as a theme park provide several

challenges. The system should be able to distinguish every individual in the park and separately track their movement continuously or as needed within the environment and ideally should be able to locate members of the group within seconds of separation if either becomes lost or separated. For this purpose, the system should provide convenient access anywhere within the environment no matter how large and should operate effectively regardless of the extent of crowding. The system also should be accurate and provide updates on location every second or so as desired. This is particularly important in tracking fast moving children who become separated from their parents.

Systems and equipment for tracking the location of moving objects such as people in real time have been described (see, e.g., U.S. Patent nos. 5,764,283 and 5,973,732), however, the inventor is not aware of any description that satisfies the requirements discussed above. Many prior systems are based on tracking by comparing video frames taken at different times. A video directed approach, however, is suited only for tracking individuals in a very limited space such as the threshold of a store. Systems that use a tagging device attached to the individual for communication via radio frequency transmission and receipt also have been described, however, such devices are used primarily for controlling portal entry to a secured area.

Thus, it would be useful to have a system and equipment for tracking individuals of a group in real time within a confined environment and to provide information to any of the group members as to the whereabouts of the other members of the group. Such system would be advantageous particularly in large areas such as theme parks, casinos, and the like.

SUMMARY OF THE INVENTION

Without intending to limit in any manner the true spirit or scope of the
5 present invention, the present system briefly described includes a user
identification Tag worn by each individual of the group, has means for
communicating with each Tag as it moves with the individual through the
environment and means for using the communication to determine the position of
the Tag in the environment. The system also uses strategically placed ID stations
10 distributed within the environment for users to activate a request that the system
locate members of the group or obtain help in assisting lost individuals. Other
advantages and various embodiments of the invention follow.

BRIEF DESCRIPTION OF THE DRAWINGS

15

The various features and advantages of the present invention will become
more clearly appreciated as a detailed description of the preferred embodiment is
given with reference to the appended drawings in which;

20 Fig. 1 is a diagrammatic view of the tracking system of the present invention
showing the location of monitoring sites, cell controllers ("cell cont."), host
computer, ID stations and Tags and an example of communication therebetween;

25 Fig. 2 is a diagrammatic of a graphical user interface ("GUI") showing a
video screen (under name of the tracking product) and buttons labeled with "Find"
and "Lost" situated below the video display;

Fig. 3 depicts a dialog box that is displayed on the video GUI of the ID station, showing the entered Tag Serial ID no. and buttons for confirming or canceling the entry;

5 Fig. 4 depicts a dialog box that is displayed on the video GUI of the ID station, providing buttons for indicating whether the user is lost or whether the user is looking for another individual of the group;

10 Fig. 5 depicts the GUI video display of the ID station showing an example of a map of an environment covered by the tracking system;

Fig. 6 depicts the GUI video display of the ID station showing an example of a map of an environment indicating the locations of individual members of a group on the map by a picture of the individual;

15 Fig. 7 is a flow chart describing the flow of information from the ID station to the host computer when an individual selects the "Find" button at the ID station display;

20 Fig. 8 is a flow chart describing the flow of information from the ID station to the host computer when an individual selects the "Lost" button at the ID station display.

25 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides a system for tracking in real-time the location of a group of individuals within a defined environment and providing

individuals of the group with the ability to locate any other individuals of the group. In general, the method includes: (a) an identification Tag worn by each individual of the group; (b) means for communicating with each Tag as it moves with the individual through the environment and means for using the
5 communication to determine the position of the Tag in the environment; (c) ID stations distributed within the environment, the stations providing a "Locate" button or other means for activating a request that the system locate members of the group; (d) means for receiving the activation request from each location and for generating a map showing the location of each group member on the map; and
10 (e) means for displaying the map at the ID station.

Briefly, an individual who carries ID Tag and is interested in determining the location of another individual of the group approaches an ID station which acts as a kiosk for participants of the system. The individual user provides the system
15 with his/her Tag Serial ID no. which activates a search to retrieve the Tag information, along with all other Tags in the cluster (i.e., the group) and locate the position of each Tag in the environment. This is accomplished by sending Tag ID nos. to the cell controllers which send out a radio signal containing the Tag ID number through a monitoring site and antenna. The person wearing the proper ID
20 Tag no. receives the signal and the Tag responds with a radio signal (at different frequency from that first sent) that includes the ID Tag number. The signal is received at the monitoring sites and relayed to the cell controllers. A Tag to antenna distance based on the time between sending the signal and receiving the signal from the Tag is calculated and used to determine the location of each
25 individual in the environment. This information is sent to the ID station which displays the location of each individual on a map. Further details and various other embodiments of the present system are provided in Figs. 1-8 as discussed below.

Fig. 1 is a diagrammatic view of an embodiment of the tracking system as applied to theme park. Individual 101 with identification Tag 102 walking on path 103 in the park comes in contact with radio signal 104 sent by antenna at monitoring site 105. Identification Tag 102 responds with radio signal (not shown) that is received by monitoring site 105 that communicates with cell controller 106. The cell controller 106 communicates with host computer 107, which communicates with ID station 108.

ID stations act as a kiosk for tagged users of the system to access and use its service properties. ID stations are strategically placed in the environment to provide ready access by ID Tag users. The ID station has a CPU and graphical user interface ("GUI"), preferably a touch screen monitor. The ID station provides the user with the ability to locate and view any Tag in the group, to post messages on a private message board or to contact security.

Suggested platform requirements of the ID station include:

ViewPoint 2.0 with Service Pack 3

Win 95

Win 98

NT 4 (Service Pack 5)

Win 2000

Suggested minimum hardware requirements of the ID station include:

233 Pentium III with 128 M RAM

800 by 600 resolution

Tags suitable for use in the system of the invention are well known in the art and are available commercially such as the "3-D -Id" Tag system sold by Pinpoint Corporation, having a place of business at Billerica, Mass. Such Tags can receive spread spectrum radio signals from monitoring site antennas and respond with a
5 signal that includes the Tag Serial ID Number. The Tag can be read at long ranges compared to conventional Radio Frequency Identification ("RFID") systems. The Tags are worn on the person preferably with a safety latch to impede easy removal.

Tags are provided to each participating member of a group when they arrive
10 at the environment. Each individual is given an individual ID Tag with its unique Serial ID no. The ID Tag no. as well as the ID Tag nos. of the other members of the group are stored in the host computer or a server connected thereto. In a preferred embodiment, a digital picture is taken of the individual and stored in the computer along with the Tag number of the individual. The software of the host
15 computer stores each ID Tag no. with a link or in a table with all the other ID Tag numbers of the group.

Fig. 2 is a schematic of a graphical user interface ("GUI") 201 provided at each ID station for communication between the host computer and the individual
20 user requesting location information. The GUI includes a large video screen 202 showing an opening screen that is displayed when the ID station is not in use. The opening screen may include the trade name of the product which is exemplified by the name "ID stations" shown in Fig. 2. "Locate" button 203 and "Lost" button 204 are shown below the video screen. These are "soft" buttons that are activated
25 by pointing and clicking with a mouse or by use of a "touch screen." An alternative embodiment uses "hard" buttons that can be physically depressed by the individual user. When approaching the GUI, the individual user will select one of

the two buttons before providing information on the identification of the individual.

Fig. 3 depicts dialog box 301 displayed on the video GUI of the ID station following the user selection of either the Locate or Lost buttons. The dialog box includes prompt 302 requesting entry of the Tag ID number or scanning of the Tag ID, display 303 shows the identification number entered or scanned. Actuation of the "OK" button 304 completes the action while actuation of the "cancel" button deletes the dialog box. These are preferably soft buttons that can be selected using mouse or by a touch screen.

Fig. 4 depicts the GUI video display 401 of the ID station. The GUI includes a large video screen 402 with map 403 of the environment where tracking is occurring. "Locate" button 404 and "Lost" button 405 are located below the video screen. As the system identifies the location of individuals of the group, an icon with a picture of the individuals is displayed on the map at their location. In an alternative embodiment, the picture can be replaced by symbol and the GUI can display a key that links the symbol with the name or picture of the individual.

Fig. 5 depicts the GUI video display 501 of the ID station. The GUI includes a large video screen 502 with map 503 of the environment where tracking is occurring showing the identities and location of individuals 504 on the map. "Locate" button 504 and "Lost" button 505 are shown below the large video display.

Fig. 6 depicts a dialog box 301 displayed on the video GUI of the ID station when the user selects the "Lost" button. The box includes prompt 602 requesting

the individual to decide if he/she is looking for someone or is lost. Actuation of the "I'm Lost" button 603 prompts the individual to stay put and sends for security. Actuation of the "I'm looking" button 604 activates the process to obtain assistance in meeting an individual of the group as described in more detail in Fig.

5 7.

Fig. 7 is a flow chart describing the flow of information from the ID station to the host computer when an individual user selects the "Locate" button at the ID station display. The user approaches the ID station seeking location information about a member of their group (shown as 701) and selects the "Locate" button from the dual option display (shown as 702) of the GUI at the ID station. The ID station prompts the user with a dialog box (see e.g., Fig. 3) requesting entry of their Tag ID number using a keyboard or using a scanning device (shown as 703). The scanning device is preferably a bar code scanner.

15 The ID station CPU sends the user Tag Serial ID no. to the host computer (shown as 704) which uses the Tag Serial ID no. to look up Tag ID nos. of the other members of the group (shown as 705). The ID station then displays a bit map of the environment which is supplemented later by the information showing the location of individuals of the group. In an alternative embodiment, the bit map is displayed only with the location of the individuals of the group.

The host computer then sends the Tag ID nos. of each individual of the group to the cell controller CPU (shown as 706) which then sends out a radio signal with the Tag Serial ID no. for each individual from the antenna of each connected monitoring site (shown as 707). The individual wearing the Tag Serial ID no. for the radio signal receives the signal and the Tag responds by transmitting a return signal containing the Tag Serial ID no. (shown as 708). The Tags receive

the radio signal at one frequency and the signal is returned by the transmitter in the Tag at a different frequency.

The monitoring sites receive the return signal which is sent to the cell controller CPU (shown as 709), which calculates a Tag to antenna distance (“TAD”) based on the time between sending the signal from the antenna and receiving a return signal from the Tag (shown as 710). The TAD data elements are the fundamental building blocks of the tracking system. In an alternative embodiment, TAD data is calculated at the host computer. Cell controllers with monitoring sites and antennas are well known in the art and are available commercially such as the “Local Positioning System (LPS) cell controller system sold by Pinpoint Corporation, having a place of business at Billerica, Mass.

Cell controllers send the TAD distance information to the main server which computes the location of the Tag Serial ID no. in the environment (shown as 711). The host computer then sends the location information of each individual to the requesting ID station CPU which displays a map showing the location of each individual of the group as an icon with their picture (shown as 712). The map is displayed for about one to two minutes before reverting to the opening screen. The map will be removed earlier if a user selects the “Locate” or “Lost” buttons. The system can be fine tuned to provide an accuracy of 10 feet or less and can update the location within seconds.

Fig. 8 is a flow chart describing the flow of information from the ID station to the host computer when an individual selects the “Lost” button at the ID station display. The individual user who becomes lost or is seeking assistance in meeting with another individual of the group approaches an ID station (shown as 801) and

selects the "Lost" button from the option display (shown as 802). The ID station prompts the user with a dialog box (see e.g. Fig. 3) requesting entry of their Tag Serial ID no. using a keyboard or by using a scanning device (shown as 803).

5 The ID station then prompts the individual with a second dialog box (see, e.g. Fig. 6) displaying buttons "I'm Lost" or "I'm Looking." If the individual selects the "I'm Lost" button, then the ID station displays a third dialog box (see e.g. Fig. 6) that asks the individual to confirm that they are lost or just looking to meet another individual ("I'm lost" or "I'm Looking") (shown as 804). If the user
10 selects "Lost," the system will instruct the lost user in accordance with the procedures and guidelines of the facility as to how to proceed in this situation. This may include display of a text message and audio message that both of which tell the user to wait by the ID station until security arrives (shown as 805). The host computer preferably simultaneously alerts security by providing the identity
15 of the contacting ID station and the Tag serial number of the lost individual (shown as 805).

 If the user selects "I'm Looking," then the host computer uses the system as described and shown for Fig. 7 to determine the identity of all members of the
20 group and sends a map for display at the ID station (shown as 806). The user then selects the individual they wish to meet by clicking or touching the icon of the appropriate individual on the map (shown as 807). The ID station responds with a voice and text message instructing the user that a security guard is being
 dispatched to the lost party and that the user should wait at the ID station (shown
25 as 808).

The present system can be used to improve safety of children particularly at large facilities such as theme parks or casinos because it can locate children, parents and even employees on a real time basis. These and other benefits include:

- 5 • Safer environment for children which gives parents peace of mind during their visit.
- Allows patrons access to the system and its information and the ability to locate a person quickly and easily through the ID stations. This saves valuable time, effort and energy.
- 10 • Provides authorities with the ability to determine quickly if a patron has wrongly entered a restricted area.
- Useful to track individuals in a large group (e.g. groups of tourists or large parties) who often separate from one another during their visit. Members of the group can quickly locate other members of their party to meet or in the
- 15 case of an emergency.
- Provides security personnel with the ability to quickly come to the aid of missing children or parents and to assist in reuniting them.
- Assists in compliance with regulatory agencies and insurance firms and in lowering insurance premiums
- 20 • Provides data for market research by being able to track the movement of customers in the business.

While the invention has been described with reference to only a limited number of embodiments, it will be appreciated that, given the preceding disclosure
25 and knowledge of the principles upon which the invention is based, be able to

make various changes and modifications without departing from the scope of the invention which is limited only by the appended claims.

CLAIMS

What is claimed is:

- 5 1. A system for tracking in real-time the location of a group of individuals within a defined environment and for providing information to any individuals of the group about the location of any other individuals of the group, comprising:
- 10 (a) identification tags having a unique identification tag number carried by each individual of the group, the tags having means for receiving a radio signal and for responding to that signal with a radio signal that includes the identification tag number;
- 15 (b) cells controllers distributed throughout the environment having radio transmission and receiving means for sending and receiving a radio signal via one or more monitoring sites, each site having an antenna for sending and receiving the signals;
- (c) means for computing a tag to antenna distance based on the time between sending the signal and receiving the signal from the tag;
- 20 (d) a host computer for storing identification tag numbers with the identity of each individual, the host computer in communication with cell controllers and ID stations, said stations accessible to individuals of the group and distributed throughout the environment and having means for communicating with individuals of the group who visit the station and for obtaining information about the location of individuals of the group.
- 25 2. A system in accordance with claim 1, wherein each cell controller transmits at a different radio wave frequency.

3. A system in accordance with claim 1, wherein said means for communicating with individuals at the station comprises a computer and a graphical user interface ("GUI");

5

4. A system in accordance with claim 3, wherein said GUI is includes a touch screen video monitor.

5. A system in accordance with claim 1, wherein said environment is selected from the group consisting essentially of theme amusement parks, casinos, hotels, zoos, ski resorts, shopping malls, homes and residences, and neighborhood associations.

6. A system in accordance with claim 1, wherein said means for communicating with individuals at the station comprises a display that offers two buttons, one for activating the system to locate an individual and one for indicating that the individual activating the button is lost.

7. A system in accordance with claim 1, wherein said means for communicating with individuals at the station includes a keyboard or a bar code scanning device.

8. A system in accordance with claim 1, wherein said means for communicating information about the location of individuals of the group at the ID station comprises the preparation of a map of the environment and display of the map at a video terminal.

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9. A system in accordance with claim 8, wherein said displayed map includes different icons for pictures each representing an individual of the group wherein the icons or pictures are located at the position on the map corresponding to the position where the individual is in the environment.

5

10. A system in accordance with claim 1, wherein said means for communicating information about the location of individuals of the group at the ID station includes a computer generated voice message.

10 11. A system in accordance with claim 6, further including connection of the host computer or ID station to a security force which is notified when the Lost button is selected.

12. A system for tracking in real-time the location of a group of individuals
15 within a defined environment and for providing information to individuals of the group about the location of any other individuals of the group, comprising:

- (a) an identification tag worn by each individual of the group;
- (b) means for communicating with each tag as it moves with the individual through the environment and means for using the communication to
20 determine the position of the tag in the environment;
- (c) ID stations distributed within the environment, said stations providing a "Locate" button or other means for activating a request that the system locate members of the group;
- (d) means for receiving the activation request from an ID station and for
25 generating a map showing the location of each group member on the map; and
- (e) means for displaying the map at the ID station.

13. A system in accordance with claim 12, wherein said means for communicating with the tags comprises various cells controllers that transmit via an antenna, a radio signal to the tag which responds by transmitting a radio signal that is received by the antenna of the cell controller.

5

14. A system in accordance with claim 13, wherein said means for using the communication to determine the position of the tag in the environment comprises a computer for calculating a tag to antenna distance based on the time between sending the signal the signal and receiving the return signal from the tag and for
10 using tag to antenna distances from each cell controller to pinpoint the position of the tag.

15. A system in accordance with claim 12, wherein said means for receiving the activation request from each location and for generating a map showing the
15 location of each group member on the map comprises a host computer

16. A system in accordance with claim 12, wherein said means for displaying the map at the activation requesting ID station includes a graphical user interface ("GUI").

20

17. A system in accordance with claim 16 wherein said GUI is includes a touch screen video monitor.

18. A system in accordance with claim 12, wherein said map displays different
25 icons or pictures each representing an individual of the group wherein the icons or pictures are located at the position on the map corresponding to the position of the individual in the environment.

19. A system in accordance with claim 12, wherein said environment is selected from the group consisting essentially of theme amusement parks, casinos, hotels, zoos, ski resorts, shopping malls, homes and residences, and neighborhood
5 associations.

20. A system in accordance with claim 1, wherein said means for activating a request that the system locate members of the group includes a keyboard or a bar code scanning device.

10 21. A system in accordance with claim 12, wherein said stations further include a "Lost" button which when activated indicates the user is lost or needs assistance to meet an individual of the group.

15 22. A system in accordance with claim 21, further including means for obtaining assistance from a security force following activation of the Lost button.

20 23. A method for tracking in real-time the location of a group of individuals within a defined environment and for providing information to individuals of the group about the location of any other individuals of the group using the system of claim 12.

25 24. A method for tracking in real-time the location of a group of individuals within a defined environment and for providing information to individuals of the group about the location of any other individuals of the group, comprising:

(a) providing individuals of the group with identification tags having a unique identification tag number, the tags having means for receiving a radio signal and for responding to that signal with a radio signal that includes the identification tag number;

5 (b) locating one or more cells controllers throughout the environment having radio transmission and receiving means for sending and receiving a radio signal via one or more monitoring sites, each site having an antenna for sending and receiving the signals;

(c) computing a tag to antenna distance based on the time between
10 sending the signal and receiving the signal from the tag;

(d) using a host computer for storing identification tag numbers with the identity of each individual, the host computer in communication with cell controllers and ID stations, said stations accessible to individuals of the group and distributed throughout the environment and having means for communicating with
15 individuals of the group who visit the station and for obtaining information about the location of individuals of the group.

25. A method in accordance with claim 24, wherein each cell controller transmits at a different radio wave frequency.

20

26. A method in accordance with claim 24, wherein said means for communicating with individuals at the station comprises a computer and a graphical user interface ("GUI");

25 27. A method in accordance with claim 26, wherein said GUI includes a touch screen video monitor.

28. A method in accordance with claim 24, wherein said environment is selected from the group consisting essentially of theme amusement parks, casinos, hotels, zoos, ski resorts, shopping malls, homes and residences, and neighborhood associations.

5

29. A method in accordance with claim 24, wherein said means for communicating with individuals at the station comprises a display that offers two buttons, one for activating the system to locate an individual and one for indicating that the individual activating the button is lost.

10

30. A method in accordance with claim 24, wherein said means for communicating with individuals at the station includes a keyboard or a bar code scanning device.

15 31. A method in accordance with claim 24, wherein said means for communicating information about the location of individuals of the group at the ID station comprises the preparation of a map of the environment and display of the map at a video terminal.

20 32. A method in accordance with claim 31, wherein said displayed map includes different icons for pictures each representing an individual of the group wherein the icons or pictures are located at the position on the map corresponding to the position where the individual is in the environment.

25 33. A method in accordance with claim 24, wherein said means for communicating information about the location of individuals of the group at the ID station includes a computer generated voice message.

34. A method in accordance with claim 29, further including connection of the host computer or ID station to a security force which is notified when the Lost button is selected.

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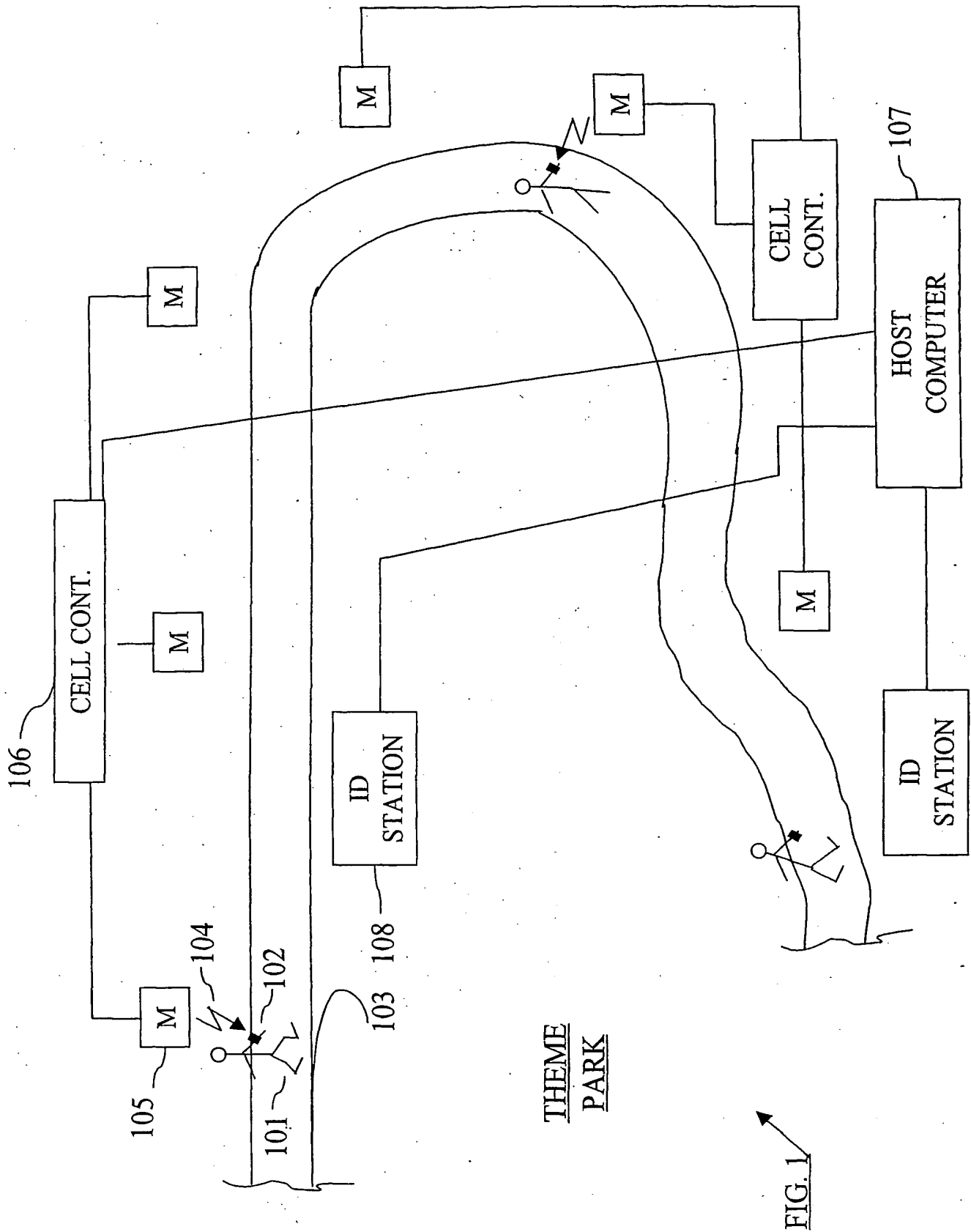


FIG. 2

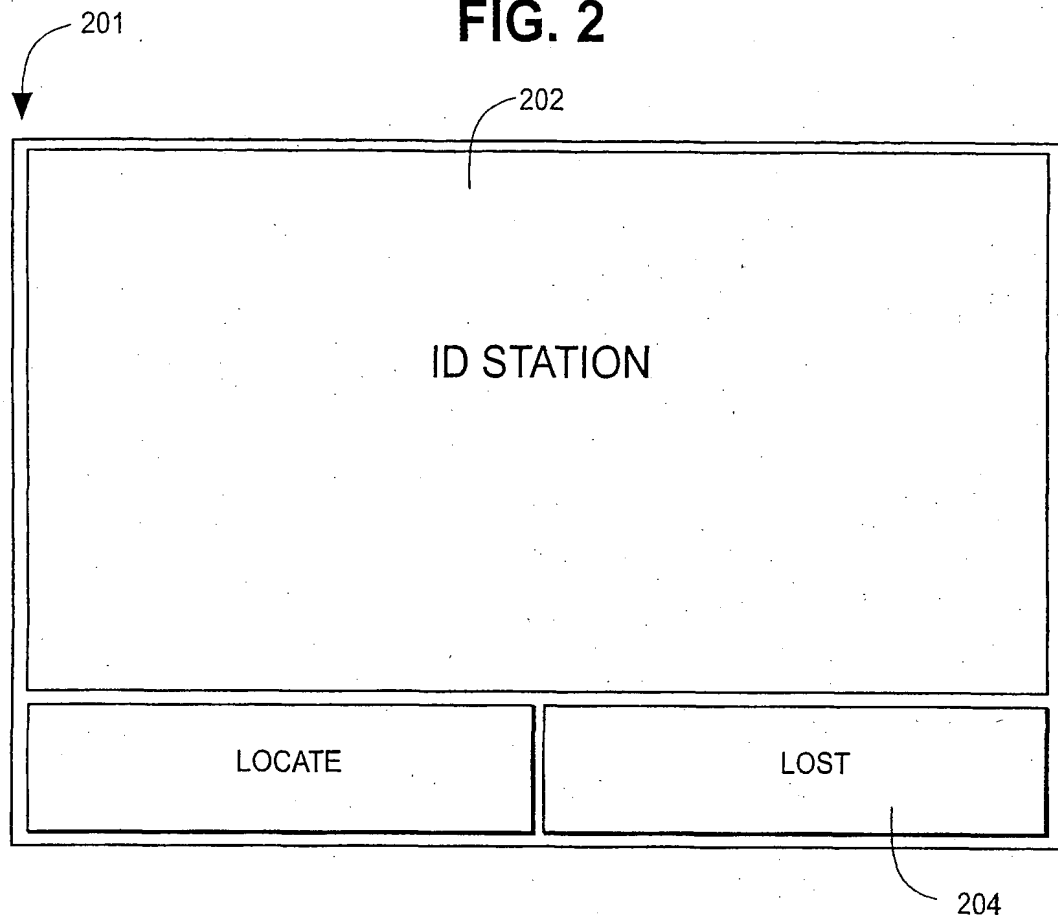


FIG. 3

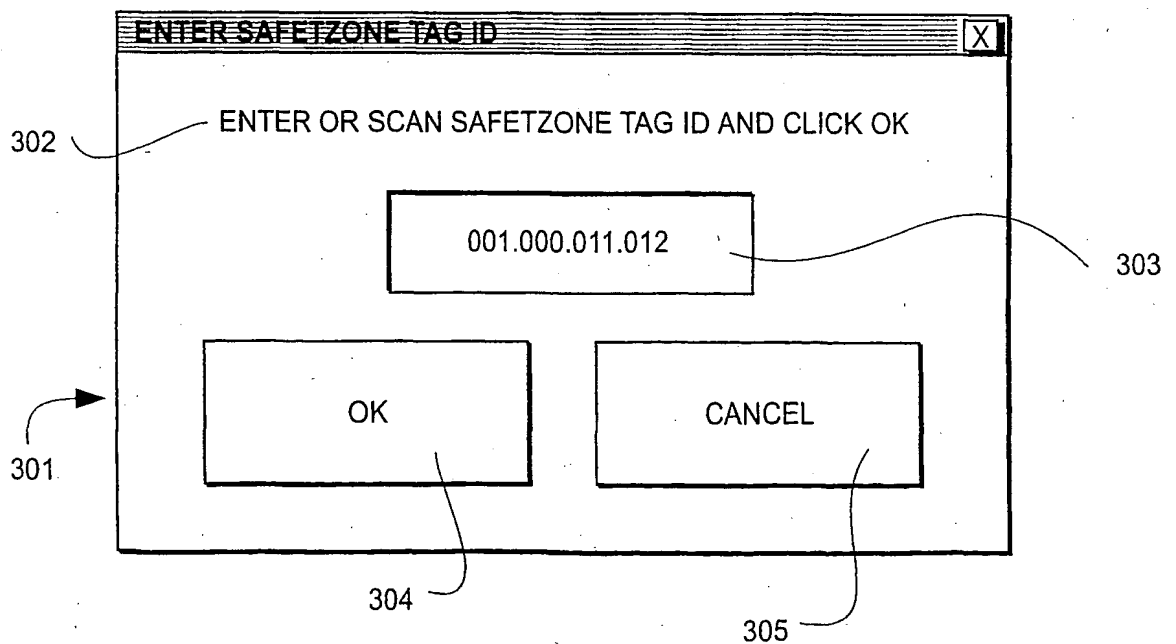


FIG. 4

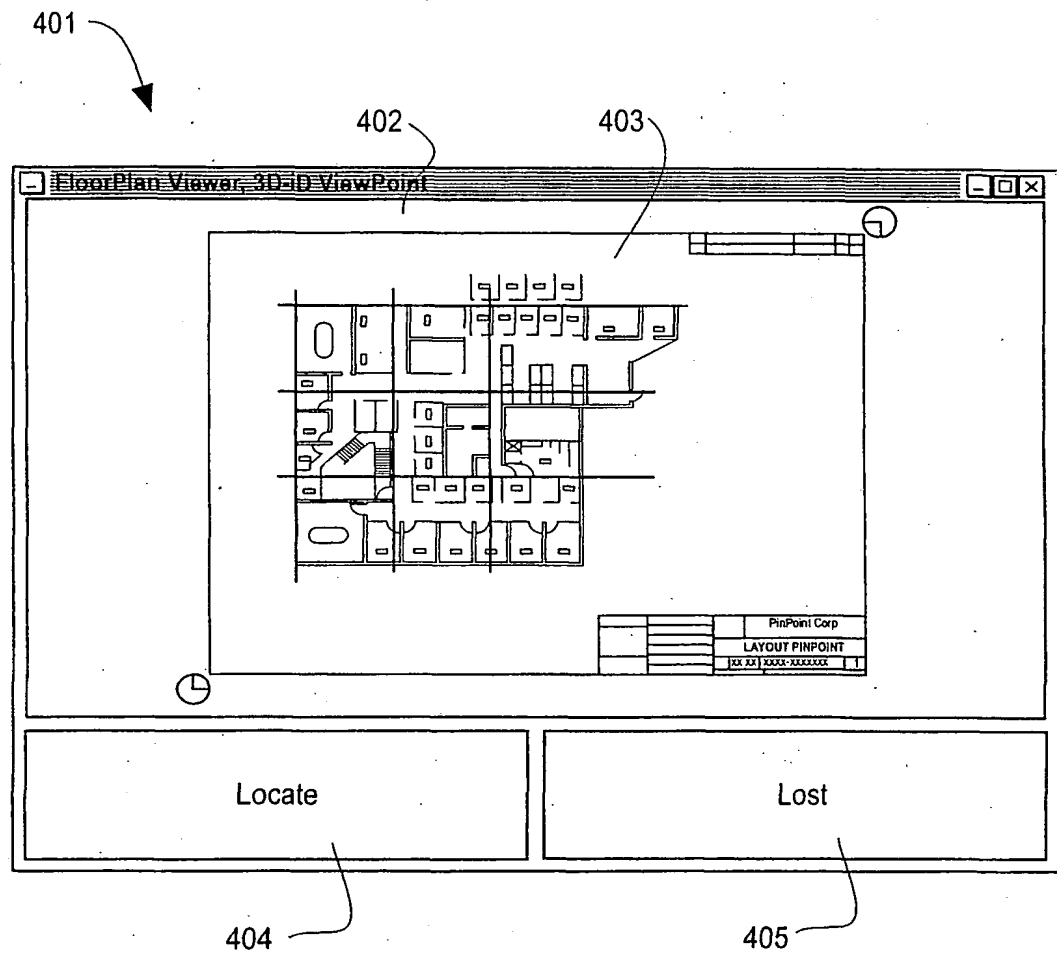


FIG. 5

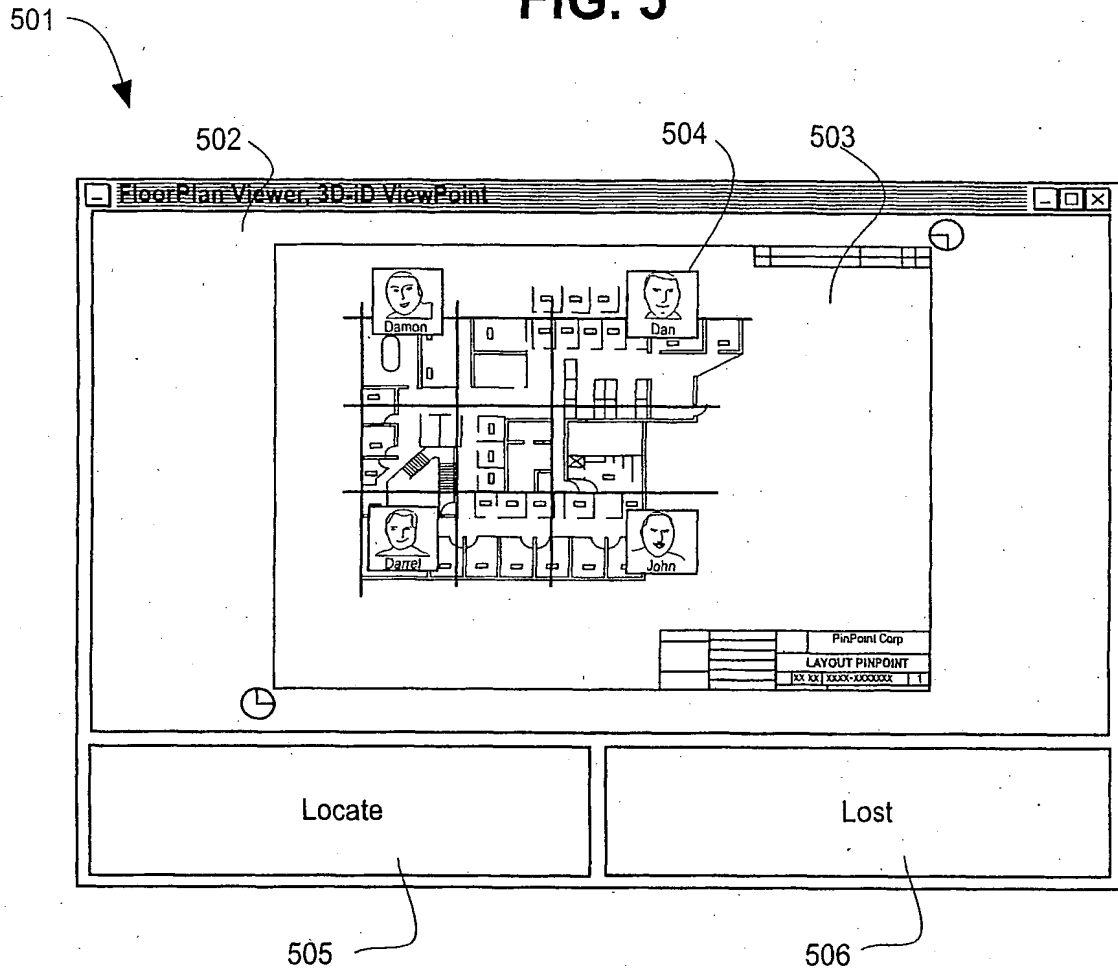
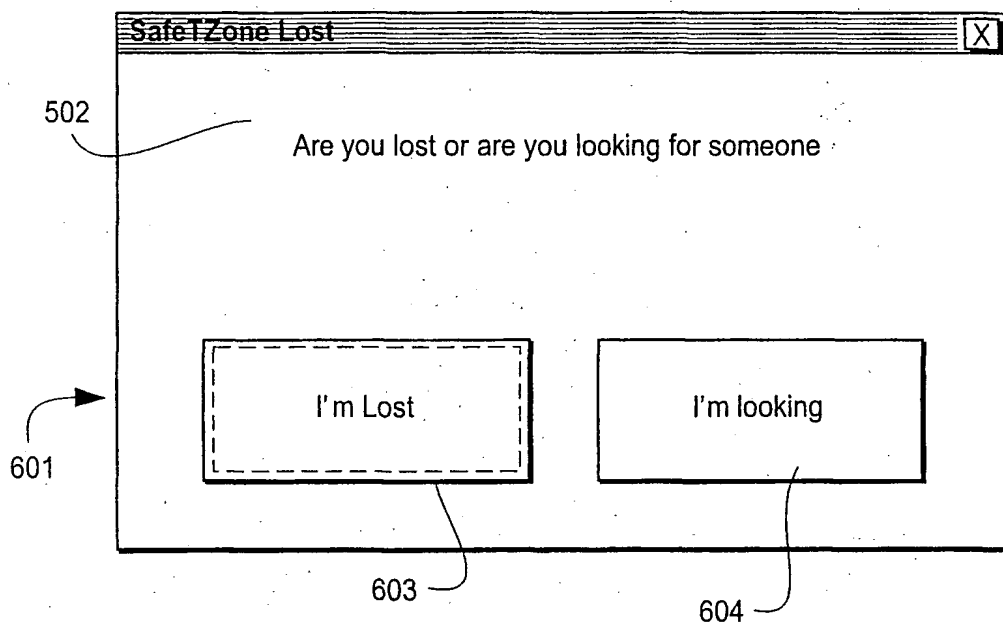


FIG. 6



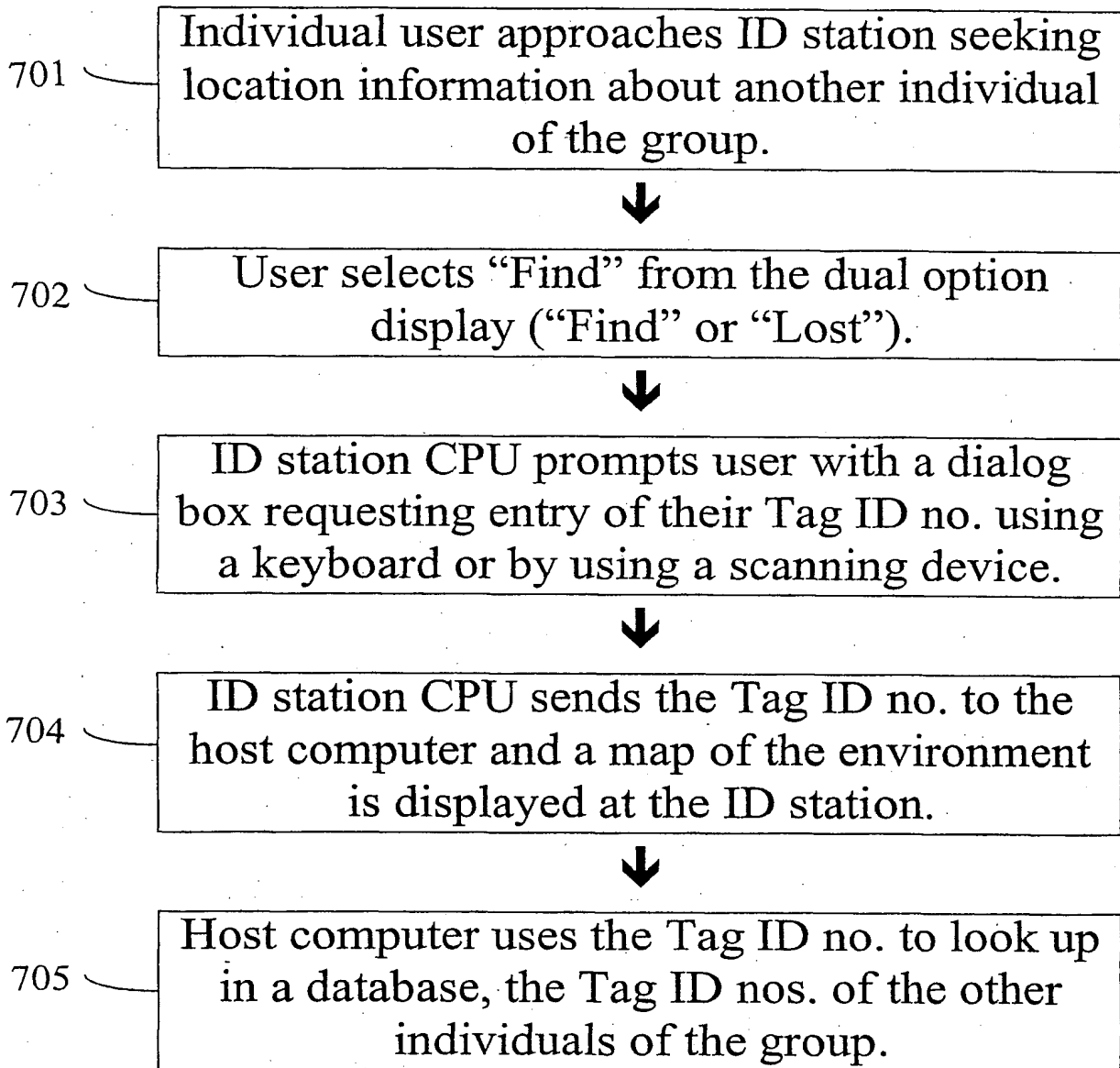
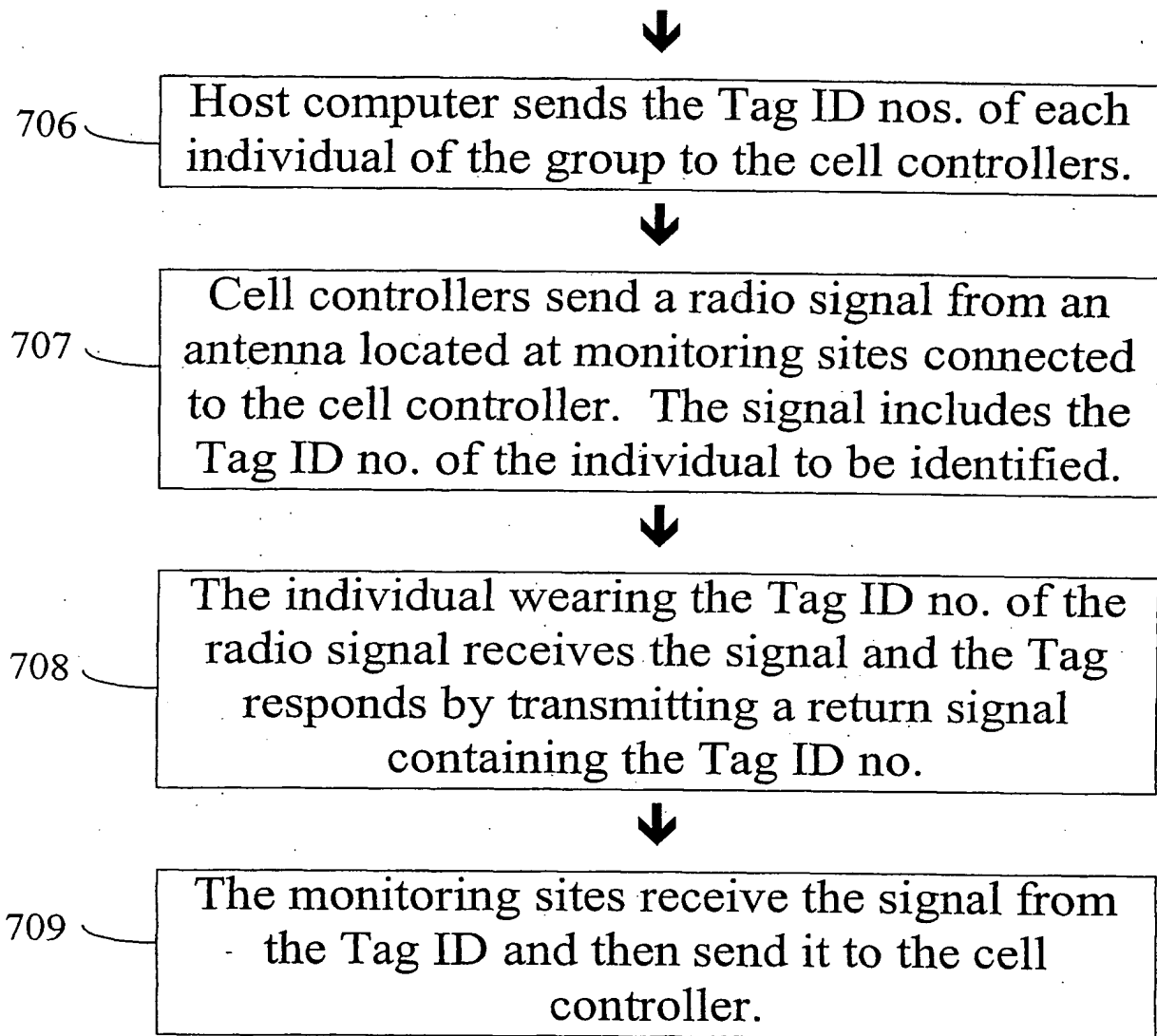
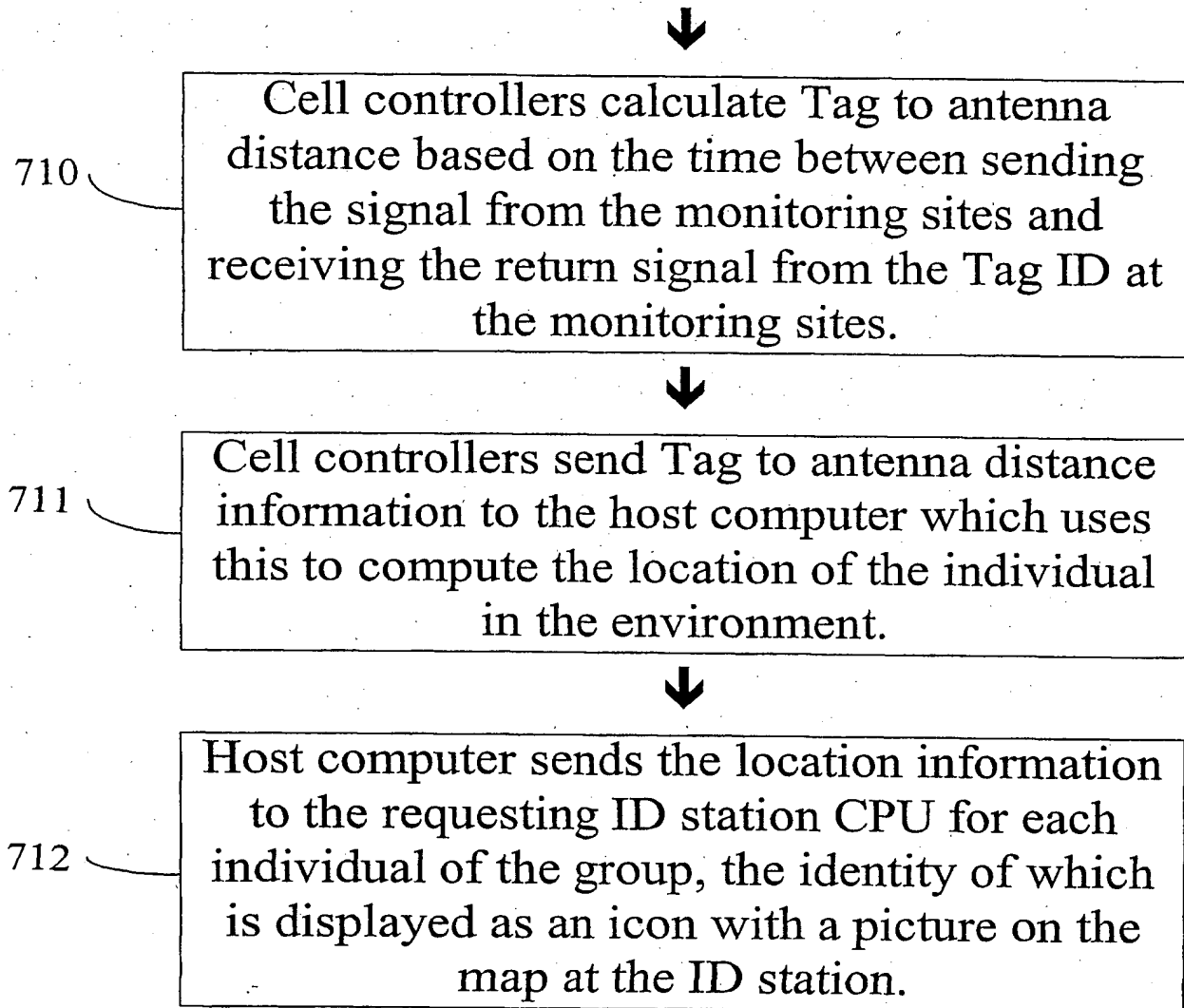
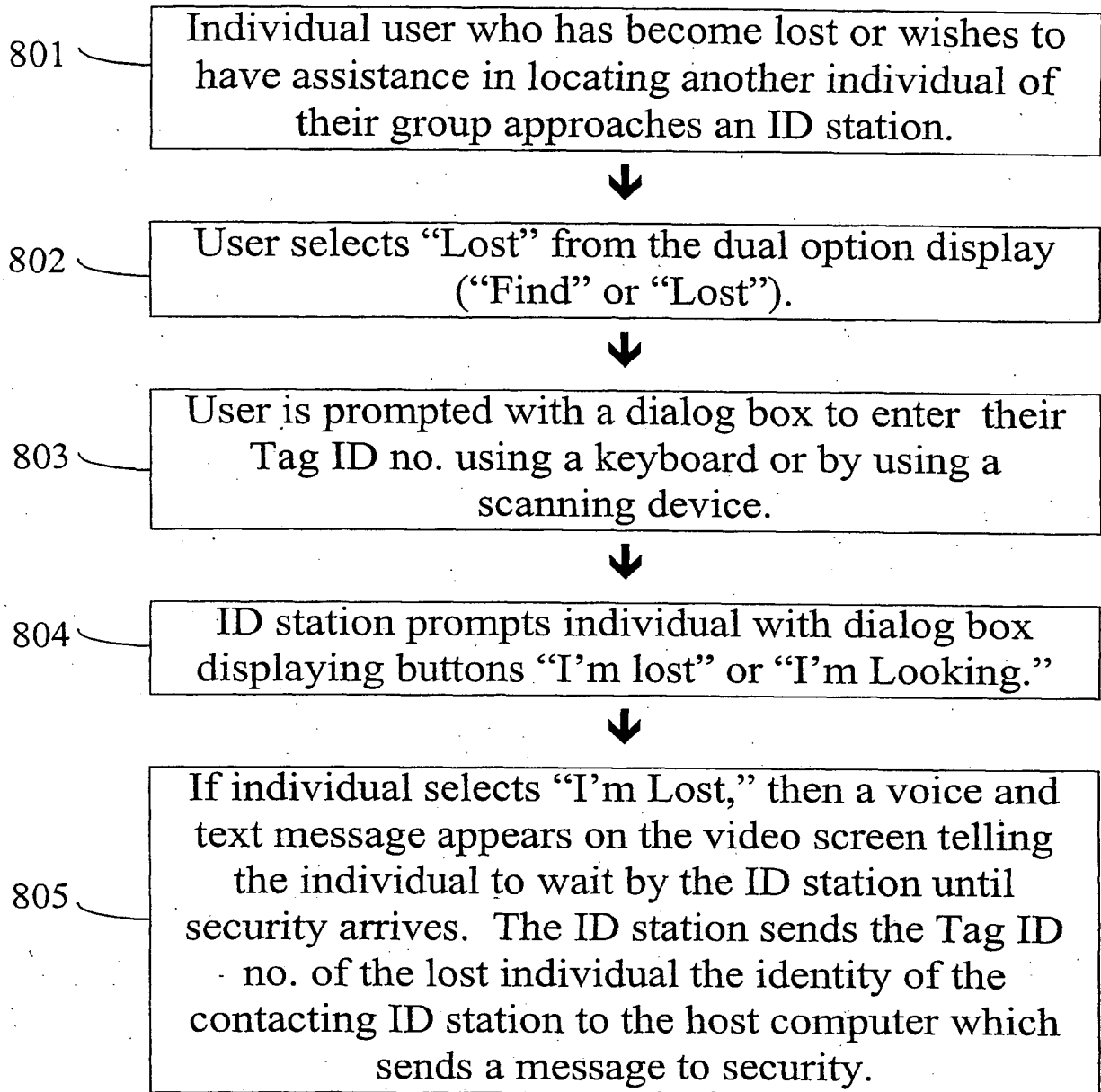
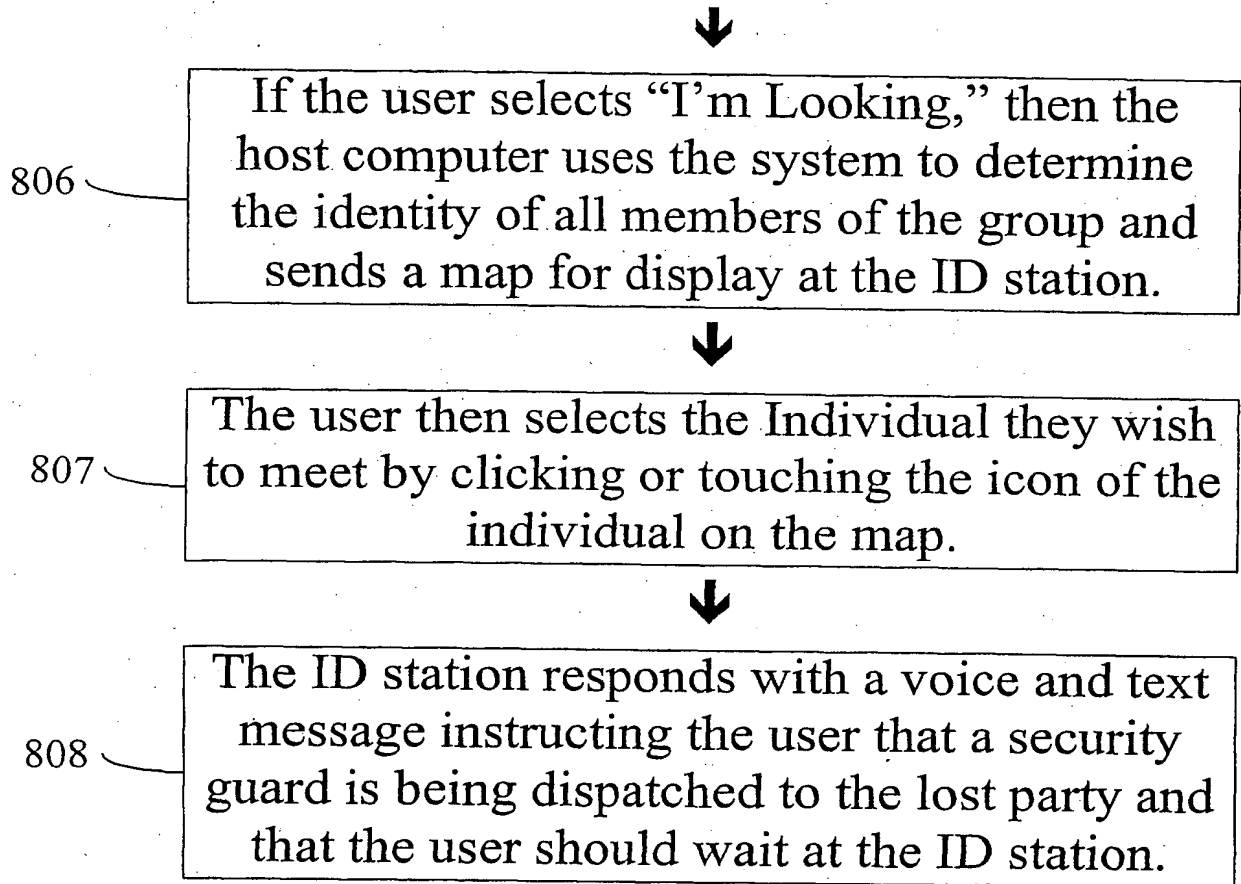


FIG. 7





 **FIG. 8**



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/35174

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G08B 13/14, 13/00, 23/00, 1/08, 5/22; G08G 1/123; H04Q 5/22

US CL : 340/572.1, 573.1, 539, 574, 825.49, 10.1, 990, 995

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/572.1, 573.1, 539, 574, 825.49, 10.1, 990, 995

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A --- Y	US 5,933,079 A (FRINK) 03 August 1999, Abstract; col. 1, lines 8-50 and col. 8, lines 24-56.	6, 11, 21-22, 29 and 34 ----- 1-5, 7-10, 12-20, 23-28 and 30-33
A --- Y	US 4,275,385 A (WHITE) 23 June 1981, whole document, especially Figs. 1 & 10 and corresponding disclosure.	6, 11, 21-22, 29 and 34 ----- 1-5, 7-10, 12-20, 23-28 and 30-33
A	US 5,977,877 A (MCCULLOCH et al.) 02 November 1999, col. 1, lines 10-17.	1-34

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

21 APRIL 2001

Date of mailing of the international search report

22 MAY 2001

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Facsimile No. (703) 305-3230

Authorized officer

BENJAMIN C. LEE

Telephone No. (703) 305-0412

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/35174

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,998,095 A (SHIELDS) 05 March 1991, Abstract.	1-34
A	US 6,057,756 A (ENGELLENNER) 02 May 2000, Abstract and Fig. 1.	1-34
A	US 6,046,688 A (HIGASHIKATA et al.) 04 April 2000, Abstract, Fig. 1 and corresponding disclosure.	1-34
A	US 5,596,313 A (BERGLUND et al.) 21 January 1997, Abstract and Figs. 1-2.	1-34
A	US 5,317,309 A (VERCELLOTTI et al.) 31 May 1994, Figs. 1a-b and corresponding disclosure.	1-34
A	US 4,598,275 A (ROSS et al.) 01 July 1986, Fig. 1 and corresponding disclosure.	1-34
A	US 5,929,848 A (ALBUKERK et al.) 27 July 1999, Abstract and Figs. 1, 2, 5a & 5d and corresponding disclosure.	1-34

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